

Morphological Variations of *Gymnodinium breve* Davis

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VARIABILITY in dinoflagellates reflects internal processes and external environment and is, therefore, useful in both taxonomic and ecological studies (Bursa, 1963). Deformed Gymnodinioideae in laboratory cultures were noted by Kofoid and Swezy (1921), Lebour (1925), and Biecheler (1952). Morphological variations of dinoflagellates under natural conditions, often induced by changes in salinity and temperature or by hydrostatic pressure, occur frequently in the vicinity of estuaries (Bursa, 1963). This paper describes several variant forms of the Florida red-tide organism, *Gymnodinium breve*, observed in field samples (Fig. 1).

The fish-killing Florida red tide is a natural phenomenon in the Gulf of Mexico associated with discolored water containing dense populations of *G. breve*. *Gymnodinium breve* also occurs in Trinidad (Lackey, 1956) and is the chief suspect related to fish mortalities that occur frequently in the Orinoco River (Gulf of Paria) (Rounsefell and Nelson, 1966).

Published material on morphological variations in *G. breve* is scarce. Since 1948, when Davis described this naked dinoflagellate as a new species, few publications have been concerned with its morphology. Lackey and Hynes (1955) gave descriptions of *G. breve*; Steidinger (1964) published two photographs of *G. breve* (from living specimens); and Steidinger and Williams (1964) defined a new variation of *G. breve* and discussed cyst formation. Variation in cultured forms was reported by Wilson (1967); he also described the most common encystment stage and the general features of reproduction.

This study is based on plankton samples collected monthly from February 1964 through February 1965 at 6 locations in Tampa Bay and Charlotte Harbor (Florida), and 16 locations in neritic waters of the Gulf of Mexico (Dragovich and Kelly, 1966). The neritic stations were positioned at 5, 10, 15, and 20 miles offshore along a series of 4 transects perpendicular to the coastline. At each station the water column was sampled at 5-m intervals from surface to bottom. Station depth varied from 5-20 m.

The five morphological variations most frequently observed during this study are described in this paper, under the arbitrary des-

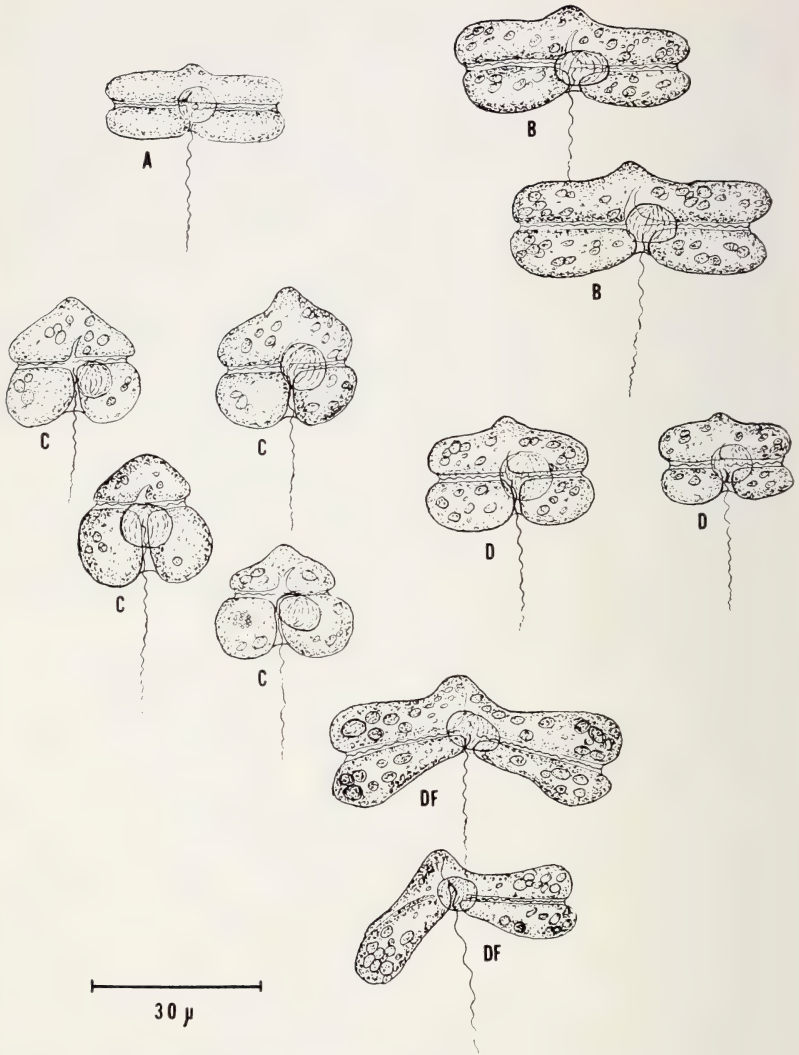


Fig. 1. Sketches of morphological variations of *Gymnodinium breve*.

ignations of forms A, B, DF, C, and D (Fig. 1). All drawings were made from living specimens.

Form A is a wide, flat cell; breadth varies from 20μ to 40μ . The cell is several times broader than long. The breadth referred to throughout this paper is the breadth across the girdle, ventral view.

Breadth is used instead of length because it is more clearly defined in *G. breve* than the length.

The cytoplasm is transparent, finely granulated, and without distinct chromatophores; in transmitted light appears pale green in color. A large nucleus is usually positioned near the center, all cells have a small apical protuberance of epicone, and a transverse groove, or girdle, is centrally located. The sulcus extends into the epicone, and both girdle and sulcus appear smooth, though slightly impressed. The organism is equipped with a transverse and a longitudinal flagellum. The transverse flagellum is within the girdle and circumscribes the cell in this form and in all other forms. No ingested food was noted.

The shape of form B is similar to that of form A but has the appearance of being slightly deformed and inflated. The breadth of the cell varies from 25μ to 60μ , and is several times greater than the length. Numerous round and discoid chromatophores are present. The clarity of the cell varies from translucent to opaque, and the appearance of the cytoplasm in transmitted light varies from light green to yellowish brown. The nucleus, epicone, sulcus, and girdle are more pronounced in form B than in form A; the flagella are the same as in A. No ingested food was observed.

Forms classified as DF are probably predivision stages of form B, but the actual division process was not observed. Form DF is generally larger than form B and measures up to 70μ wide. The cell is butterfly-shaped, and some cells have a split along the sulcus up to the epicone.

The shape of form C is suboval, and the cell breadth varies from 18μ to 40μ . The cell may contain numerous oval, suboval, and discoid chromatophores or may be without distinct chromatophores. Cell color usually is pale green or yellowish green, and the cell may be transparent, translucent, or opaque. The distinct nucleus is located centrally; in some cells, it is contained entirely in the hypocone. The epicone is smaller than the hypocone in some specimens, and the apical protuberance of the epicone was not observed in all cells. The sulcus (which extends into the epicone and at times branches) and girdle are pronounced and impressed. Cells have flagella as do forms A and B. No ingested food was noted. Form C was similar to the typical mature *G. breve* cell in cultures described by Wilson (1967).

Form D is intermediate between forms B and C, but is neither as wide as form B nor as flat as form C. The apical protuberance of the epicone and the nucleus, chromatophores, sulcus, girdle, flagellae, and color are similar to form B.

The described forms occurred at all depths; at times, all forms were present in single samples. Although similar forms were observed in earlier investigations, records of their occurrence in the field samples were made for the first time in the present study.

Form C occurred more frequently than the others and was the only one found in Charlotte Harbor (Florida). Studies have disclosed occurrences of form B during bloom and nonbloom periods of red tide. Form A occurred in the offshore waters through most of the year, but was never seen in bloom proportions. Form D was present throughout the area, but was less frequent than forms A, B, and C.

From an ecological point of view, form A may indicate unfavorable conditions for the development of red tide, and form B (and DF) favorable conditions. Forms C and D may be regarded as ecologically intermediate forms between A and B (and DF).

Culturing of these forms from single cell isolates will be required to determine whether they are the same species. Observations of unialgal cultures of *G. breve* have shown that forms B and DF may transform into type C cells (John H. Finucane, personal communication). Thus it is possible that these forms belong to the same species. Wilson (1967) reported that some of the irregularly-shaped *G. breve* cells reverted to normal cells when transferred individually with a micropipette to fresh medium.

The facts that forms observed under natural conditions and in culture differed from the original description (Davis, 1948) suggest that further and more detailed research on taxonomy and ecology of *G. breve* is needed.

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